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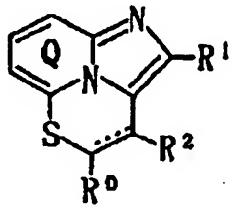

(I)

(57) Abstract

A novel compound of formula (I) wherein ring Q is an optionally substituted pyridine ring; one of R^0, R^1 and R^2 is $-Y^0-Z^0$, and the other two groups are a hydrogen, a halogen, an optionally substituted hydroxy group, a hydrocarbon group that may be an optionally substituted hydrocarbon group or an acyl group; Y^0 is a bond or an optionally substituted bivalent hydrocarbon group; Z^0 is a basic group which may be bonded via oxygen, nitrogen, -CO-, -CS-, $-SO_2N(R^3)-$ (where R^3 is hydrogen or an optionally substituted hydrocarbon group), or $S(O)_n$ (wherein n is to 0, 1 or 2); ..... is a single bond or a double bond, or a salt thereof, which has an excellent LDL receptor up-regulating, blood-lipids lowering, blood-sugar lowering and diabetic complication-ameliorating activity.

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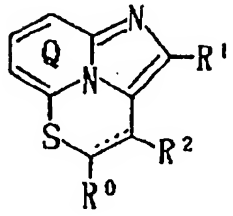
CLAIMS

1. A compound of the formula:

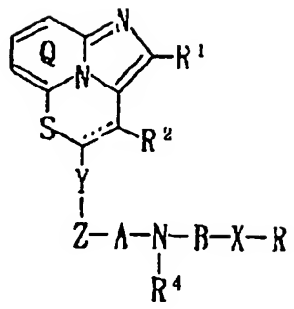


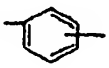
wherein ring Q is an optionally substituted pyridine ring;
one of R^0, R^1 and R^2 is $-Y^0-Z^0$, and the other two groups are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
Y^0 is a bond or an optionally substituted divalent hydrocarbon group;
Z^0 is a basic group which may be bonded via oxygen, nitrogen, -CO-, -CS-, $-SO_2N(R^3)-$ (wherein R^3 is a hydrogen or an optionally substituted hydrocarbon group), or
-S(O)n- (wherein n is 0, 1 or 2); and
⚌ is a single bond or a double bond, or a salt thereof.

2. A compound of claim 1, wherein R^0 is $-Y^0-Z^0$, wherein Y^0 and Z^0 are of the same meanings as defined in calim 1.

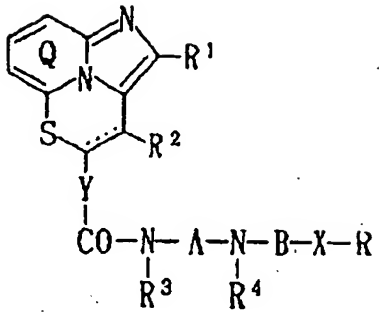
3. A compound of claim 1, wherein Z^0 is a group with a molecular weight of not greater than 1000.

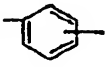
4. A compound of claim 1 which is a compound of the formula:



wherein ring Q is an optionally substituted pyridine ring;
A and B independently are an optionally substituted divalent hydrocarbon group which may be bonded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$;
X is a bond, oxygen, sulfur, $-N(R^5)CO-$, $-CO(R^5)-$, $-CO-$ or $-N(R^5)-$;
Y is a bond, $-CH=CH-$ or $-CH=CH$  ;
Z is $-CO-$, $-COO-$, $-CON(R^3)-$, $-SO_2N(R^3)-$ or $-S(O)m-$ (wherein m is 0, 1 or 2);
R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3, R^4, R^{4a} and R^5 independently are a hydrogen or an optionally substituted hydrocarbon group; or
R^3 and A, R^4 and A, R^4 and B, R^4 and R^5, or R^4 and R may independently be bonded to each other to form a ring;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group; and
$=\!=\!=\!=\!=$ is a single bond or a double bond, or a salt thereof.

5. A compound of claim 1 which is a compound of the formula:



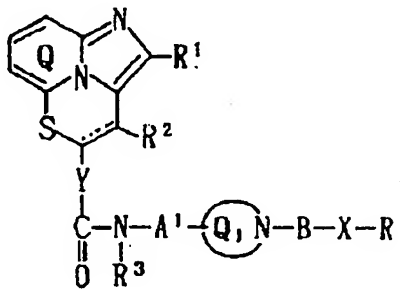
wherein ring Q is an optionally substituted pyridine ring;
A and B independently are an optionally substituted divalent hydrocarbon group which may be bonded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$;
X is a bond, oxygen, sulfur, $-N(R^5)CO-$, $-CO(R^5)-$, $-CO-$ or $-N(R^5)-$;
Y is a bond, $-CH=CH-$ or $-CH=CH$  ;
Z is $-CO-$, $-COO-$, $-CON(R^3)-$, $-SO_2N(R^3)-$ or $-S(O)m-$ (wherein m is 0, 1 or 2);
R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3, R^4, R^{4a} and R^5 independently are a hydrogen or an optionally substituted hydrocarbon group; or
R^3 and A, R^4 and A, R^4 and B, R^4 and R^5, or R^4 and R independently may be bonded to each other to form a ring;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group; and
------ is a single bond or a double bond, or a salt thereof.

6. A compound of claim 5, wherein A and B independently are an alkylene group; X is a bond; and

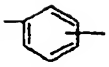
R^3 and R^4 independently are a hydrogen or an optionally substituted alkyl, cycloalkyl, alkenyl, aralkyl or aryl group.

7. A compound of claim 5, wherein ring Q is an unsubstituted pyridine ring; X is a bond; Y is a bond,  ; A and B independently are a C_{1-15} ; alkylene group; R^1 and R^2 independently are a hydrogen; R^3 and R^4 independently are a hydrogen or a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} aralkyl or C_{6-14} aryl group; and R is a C_{6-14} aryl group.

8. A compound of claim 1 which is a compound of the formula:

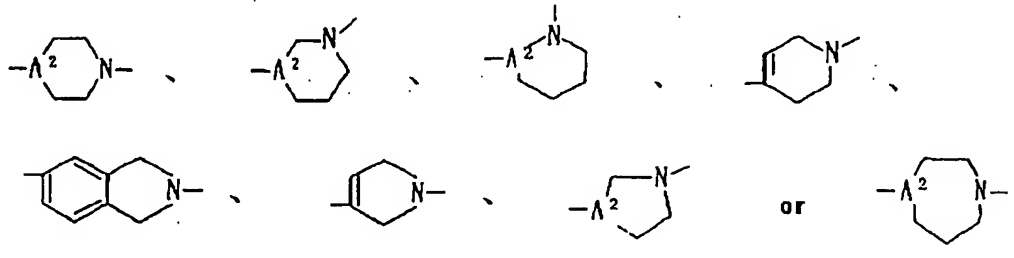


wherein ring Q is an optionally substituted pyridine ring;
ring Q_1 is an optionally substituted nitrogen-containing heterocyclic ring;
A^1 is a bond or an optionally substituted divalent hydrocarbon group which may be bonded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$;
B is an optionally substituted divalent hydrocarbon group;
X is a bond, oxygen, sulfur, $-N(R^5)CO-$, $-CO(R^5)-$, $-CO-$ or $-N(R^5)-$;

Y is a bond, -CH=CH- or -CH=CH  ;

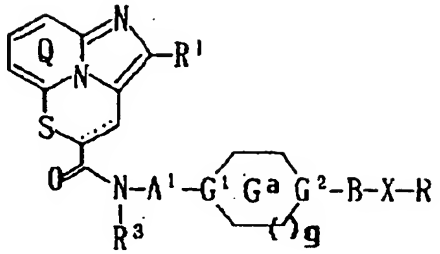
R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3 , R^{4a} and R^5 independently are a hydrogen or an optionally substituted hydrocarbon group; or
R^3 and A^1 may be bonded to each other to form a ring;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group; and
 is a single bond or a double bond, or a salt thereof.

9. A compound of claim 8, wherein ring Q is an unsubstituted pyridine ring; R^1 and R^2 are a hydrogen; R^3 is a hydrogen or a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} arlkyl or C_{6-14} aryl group; A^1 is (i) a bond, (ii) a C_{1-15} alkylene group which may be substituted by 1 to 3 substituents selected from the group consisting of hydroxy, oxo and phenyl, (iii) a C_{2-16} alkenylene group or (iv) a phenylene group; B is (i) a C_{1-15} alkylene group which may be substituted by 1 to 3 substituents selected from the group consisting of hydroxy, oxo and phenyl, (ii) a C_{2-16} alkenylene group or (iii) a phenylene group; ring Q_1 is a group of the formula:



wherein A^2 is =C or CH; X is a bond, oxygen, sulfur or -CON(R^5)-; R^5 is a hydrogen or a C_{1-15} alkyl group.

10. A compound of claim 1 which is a compound of the formula:



wherein ring Q is an optionally substituted pyridine ring;
A^1 is a bond or an optionally substituted divalent hydrocarbon group which may be bonded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$;
B is an optionally substituted divalent hydrocarbon group;
X is a bond, oxygen, sulfur, $-N(R^5)CO-$, $-CON(R^5)-$, $-CO-$ or $-N(R^5)-$;
R^1 is a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3 , R^{4a} and R^5 independently are a hydrogen or an optionally substituted hydrocarbon group;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group;
one of G^1 and G^2 is N, and the other is CH or N;
ring G^a is an optionally substituted ring;
g is 0, 1 or 2; and
$=\!=\!=\!=\!=$ is a single bond or a double bond, or a salt thereof.

11. A compound of claim 10, wherein ring Q is a pyridine ring which may be substituted by 1 to 3 substituents selected from the group consisting of nitro, hydroxy, cyano, carbamoyl, mono- or di-C_{1-4}

alkyl-carbamoyl, carboxy, C_{1-4} alkoxy-carbonyl, sulfo, halogen, C_{1-4} alkoxy, phenoxy, naphthoxy, benzyloxy, halophenoxy, C_{1-4} alkylthio, mercapto, phenylthio, pyridylthio, C_{1-4} alkylsulfinyl, phenylsulfinyl, C_{1-4} alkylsulfonyl, phenylsulfonyl, amino, C_{1-3} acylamino, mono- or di-C_{1-4} alkylamino, C_{1-4} alkyl and C_{1-4} haloalkyl.

12. A compound of claim 10, A^1 is a bond or a C_{1-15} alkylene, C_{2-16} alkenylene group which may be bonded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$, wherein R^{4a} is of the same meaning as defined in claim 10.

13. A compound of claim 10, B is a C_{1-15} alkylene or C_{2-16} alkenylene group.

14. A compound of claim 10, X is a bond, oxygen, sulfur, -CONH- or -CO-.

15. A compound of claim 10, R^1 is (1) a hydrogen, (2) a halogen, (3) a hydroxy group which may be substituted by a C_{1-6} alkyl, phenyl, C_{7-10} aralkyl, formyl, C_{1-6} alkyl-carbonyl, phenyloxycarbonyl, C_{7-10} aralkyloxy-carbonyl, pyranyl, furanyl or silyl group, (4) a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} aralkyl or C_{6-14} aryl group or (5) a C_{1-6} alkoxy-carbonyl, mono-C_{1-6} alkyl-carbamoyl, di-C_{1-6} alkyl-carbamoyl or C_{1-10} alkanoyl group.

16. A compound of claim 10, R^3 is a hydrogen or a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} aralkyl or C_{6-14} aryl group.

17. A compound of claim 10, R is (1) a C_{1-15} alkyl, C_{3-8}

cycloalkyl or C_{2-18} alkenyl group which may be substituted by 1 to 5 substituents selected from the group consisting of (i) nitro, (ii) hydroxy, (iii) cyano, (iv) carbamoyl, (v) mono- or di-C_{1-4} alkyl-carbamoyl, (vi) carboxy, (vii) C_{1-4} alkoxy-carbonyl, (viii) sulfo, (ix) halogen, (x) C_{1-4} alkoxy, (xi) phenoxy, (xii) halophenoxy, (xiii) C_{1-4} alkylthio, (xiv) mercapto, (xv) phenylthio, (xvi) pyridylthio, (xvii) C_{1-4} alkylsulfinyl, (xviii) C_{1-4} alkylsulfonyl, (xix) amino, (xx) C_{1-3} alkanoylamino, (xxi) mono- or di-C_{1-4} alkylamino, (xxii) 4- to 6-membered cyclic amino, (xxiii) C_{1-3} alkanoyl, (xxiv) benzoyl and (xxv) 5- to 10-membered heterocyclic group;

(2) a C_{7-16} aralkyl group which may be substituted by 1 to 4 substituents selected from the group consisting of (i) halogen, (ii) C_{1-4} alkyl, (iii) C_{2-6} alkenyl, (iv) C_{1-3} alkanoyl, (v) C_{1-4} alkoxy, (vi) nitro, (vii) cyano, (viii) hydroxy, (ix) C_{1-4} alkoxy-carbonyl, (x) carbamoyl, (xi) mono- or di-C_{1-4} alkyl-carbamoyl and (xii) mono- or di-C_{2-4} alkenyl-carbamoyl;

(3) a C_{6-14} aryl group which may be substituted by 1 to 4 substituents selected from the group consisting of (i) halogen, (ii) C_{1-4} alkyl, (iii) C_{1-4} haloalkyl, (iv) C_{1-4} haloalkoxy, (v) C_{1-4} alkoxy, (vi) C_{1-4} alkylthio, (vii) hydroxy, (viii) carboxy, (ix) cyano, (x) nitro, (xi) amino, (xii) mono- or di-C_{1-4} alkylamino, (xiii) formyl, (xiv) mercapto, (xv) C_{1-4} alkyl-carbonyl, (xvi) C_{1-4} alkoxy-carbonyl, (xvii) sulfo, (xviii) C_{1-4} alkylsulfonyl, (xix) carbamoyl, (xx) mono- or di-C_{1-4} alkyl-carbamoyl, (xxi) oxo and (xxii) thioxo; or

(4) a 5- or 6-membered monocyclic heterocyclic group containing 1 to 4 hetero-atoms selected from oxygen, sulfur and nitrogen or a fused bicyclic heterocyclic group containing 1 to 6 hetero-atoms selected from oxygen, sulfur and nitrogen, each of which may be

substituted by 1 to 4 substituents selected from the group consisting of (i) halogen, (ii) C_{1-4} alkyl, (iii) C_{1-4} haloalkyl, (iv) C_{1-4} haloalkoxy, (v) C_{1-4} alkoxy, (vi) C_{1-4} alkylthio, (vii) hydroxy, (viii) carboxy, (ix) cyano, (x) nitro, (xi) amino, (xii) mono- or di-C_{1-4} alkylamino, (xiii) formyl, (xiv) mercapto, (xv) C_{1-4} alkyl-carbonyl, (xvi) C_{1-4} alkoxy-carbonyl, (xvii) sulfo, (xviii) C_{1-4} alkylsulfonyl, (xix) carbamoyl, (xx) mono- or di-C_{1-4} alkyl-carbamoyl, (xxi) oxo and (xxii) thioxo.

18. A compound of claim 10, wherein ring G^a is a ring which may be substituted by 1 or 2 substituents selected from the group consisting of oxo and C_{1-6} alkyl.

19. A compound of claim 10, wherein ring Q is an unsubstituted pyridine ring; R^1 and R^3 are a hydrogen; G^1 is CH; G^2 is N; g is 1; and R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group.

20. A compound of claim 19, wherein ring G^a is unsubstituted ring.

21. A compound of claim 19, wherein A^1 is a bond or a C_{1-6} alkylene group.

22. A compound of claim 19, wherein A^1 is a bond.

23. A compound of claim 19, wherein B is a C_{1-6} alkylene group.

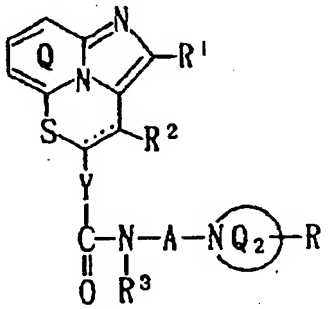
24. A compound of claim 19, X is a bond.

25. A compound of claim 10, ring Q is an unsubstituted pyridine ring; R^1 and R^3 are a hydrogen; A^1 is a bond; G^1 is CH; G^2 is N; ring G^a is a ring which may be substituted by 1 or 2 substituents selected from the group consisting of oxo and C_{1-6} alkyl; g is 1; B is a C_{1-6} alkylene group; X is a bond; and R is an optionally substituted phenyl group.

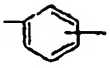
26. A compound of claim 25, ring G^a is unsubstituted ring.

27. A compound of claim 25, wherein R is a phenyl group which may be substituted by 1 to 3 substituents selected from the group consisting of halogen, hydroxy, C_{1-4} alkyl, C_{1-4} haloalkyl, C_{1-4} alkoxy and C_{1-4} haloalkoxy.

28. A compound of claim 1 which is a compound of the formula:

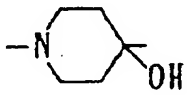


wherein ring Q is an optionally substituted pyridine ring;
ring Q_2 is an optionally substituted nitrogen-containing heterocyclic ring;
A is an optionally substituted divalent hydrocarbon group which may be bounded via $-CON(R^{4a})-$, $-CO-$ or $-N(R^{4a})-$;

Y is a bond, -CH=CH- or -CH=CH  ;

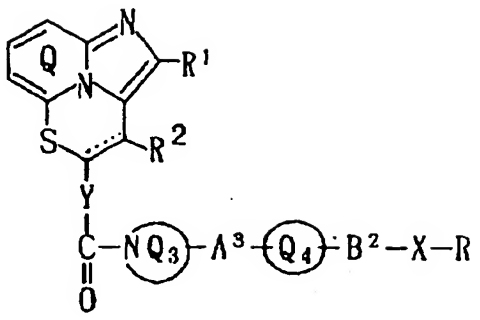
R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3 and R^{4a} independently are a hydrogen or an optionally substituted hydrocarbon group; or
R^3 and A may be bonded to each other to form a ring;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group; and
 is a single bond or a double bond, or a salt thereof.

29. A compound of claim 28, wherein ring Q is an unsubstituted pyridine ring; R^1 and R^2 are a hydrogen; R^3 is a hydrogen or a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} aralkyl or C_{6-14} aryl group; A is (i) a C_{1-15} alkylene group which may be substituted by 1 to 3 substituents selected from the group consisting of hydroxy, oxo and phenyl, (ii) a C_{2-16} alkenylene group or (iii) a phenylene group; ring Q_2 is a group of the formula:

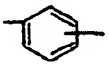
 or 

wherein B^1 is =C, CH or N.

30. A compound of claim 1 which is a compound of the formula:

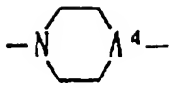


wherein ring Q is an optionally substituted pyridine ring;
ring Q_3 and Q_4 independently are an optionally substituted nitrogen-containing heterocyclic ring;
A^3 and B^2 independently are a bond or an optionally substituted divalent hydrocarbon group;
X is a bond, oxygen, sulfur, $-N(R^5)CO-$, $-CON(R^5)-$, $-CO-$ or $-N(R^5)-$;

Y is a bond, $-CH=CH-$ or $-CH=CH$  ;

R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^5 is a hydrogen or an optionally substituted hydrocarbon group;
R is an optionally substituted hydrocarbon group or an optionally substituted heterocyclic group; and
$\overline{\quad\quad}$ is a single bond or a double bond, or a salt thereof.

31. A compound of claim 30, wherein ring Q is an unsubstituted pyridine ring; R^1 and R^2 are a hydrogen; A^3 and B^2 independently are a bond or a C_{1-15} alkylene, C_{2-16} alkenylene or phenylene group; ring Q_3 is a group of the formula:

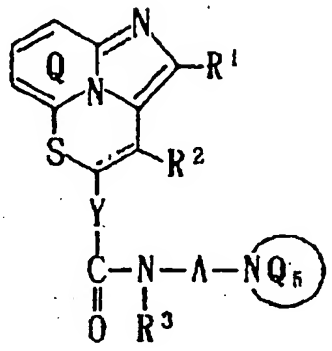


wherein A^4 is =C or CH; ring Q_4 is a group of the formula:

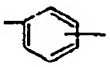
 or 

wherein A^5 is =C or CH.

32. A compound of claim 1 which is a compound of the formula:



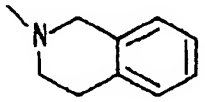
wherein ring Q is an optionally substituted pyridine ring;
ring Q_5 is an optionally substituted nitrogen-containing heterocyclic ring;
A is an optionally substituted divalent hydrocarbon group which may be bonded via $-CON(R^{4a})-$, -CO- or $-N(R^{4a})-$;

Y is a bond, -CH=CH- or -CH=CH  ;

R^1 and R^2 independently are a hydrogen, a halogen, an optionally substituted hydroxy group, an optionally substituted hydrocarbon group or an acyl group;
R^3 and R^{4a} independently are a hydrogen or an optionally substituted hydrocarbon group; and

⚌⚌⚌⚌⚌ is a single bond or a double bond, or a salt thereof.

33. A compound of claim 32, wherein ring Q is an unsubstituted pyridine ring; R^1 and R^2 are a hydrogen; R^3 is a hydrogen or a C_{1-15} alkyl, C_{3-8} cycloalkyl, C_{2-18} alkenyl, C_{7-16} aralkyl or C_{6-14} aryl group; A is a C_{1-15} alkylene, C_{2-16} alkenylene or phenylene group; ring Q_5 is a group of the formula:



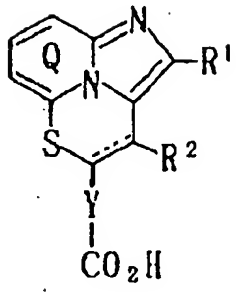
34. A compound of claim 1 which is (R)-N-[1-(1,4-benzodioxan-2-ylmethyl)piperidin-4-ylmethyl]-5-thia-1,8b-diazaacenaphthylene-4-carboxamide, or a pharmaceutically acceptable salt thereof.

35. A compound of claim 1 which is N-[1-(3-phenylpropyl)piperidin-4-ylmethyl]-3-(5-thia-1,8b-diaza acenaphthylene-4-yl)acrylamide, or a pharmaceutically acceptable salt thereof.

36. A compound of claim 1 which is N-[4-(4-phenylpiperidin-1-yl)butan-1-yl]-5-thia-1,8b-diazaacena phthylene-4-carboxamide, or a pharmaceutically acceptable salt thereof.

37. A compound of claim 1 which is N-[1-(3-phenylpropan-1-yl)piperidin-4-yl]-5-thia-1,8b-diazaacen aphthylene-4-carboxamide, or a pharmaceutically acceptable salt thereof.

38. A process for producing a compound of claim 5, which comprises condensing a compound of the formula:

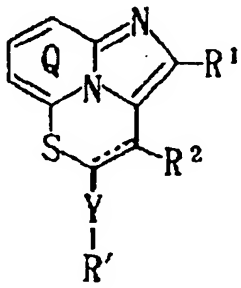


wherein all symbols are of the same meanings as defined in claim 5, or a salt thereof with a compound of the formula:

R^3-NH-A-N(R^4)-B-X-R

wherein all symbols are of the same meanings as defined in claim 5, or a salt thereof.

39. A compound of the formula:



wherein R' is an optionally protedcted COOH, CH_2OH or CHO group; and the other symbols are of the same meanings as defined in claim 4, or a salt thereof.

40. A pharmaceutical composition which comprises a compound of claim 1.

41. A pharmaceutical composition of claim 40, which is an up-regulater of low density lipoprotein receptor.

42. A pharmaceutical composition of claim 40, which is a therapeutic agent for lowering lipids in blood.

43. A pharmaceutical composition of claim 40, which is a therapeutic agent for atherosclerosis.

44. A pharmaceutical composition of claim 40, which is an agent for lowering blood sugar.

45. A pharmaceutical composition of claim 40, which is a therapeutic agent for diabetic complications.

46. Use of a compound of claim 1 for the manufacture of a medicament for lowering lipids in blood.

47. Method for lowering lipids in blood in a mammal which comprises administering to said mammal an effective amount of a compound of claim 1.